ASSIGNMENT 3

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Section: IOT_608
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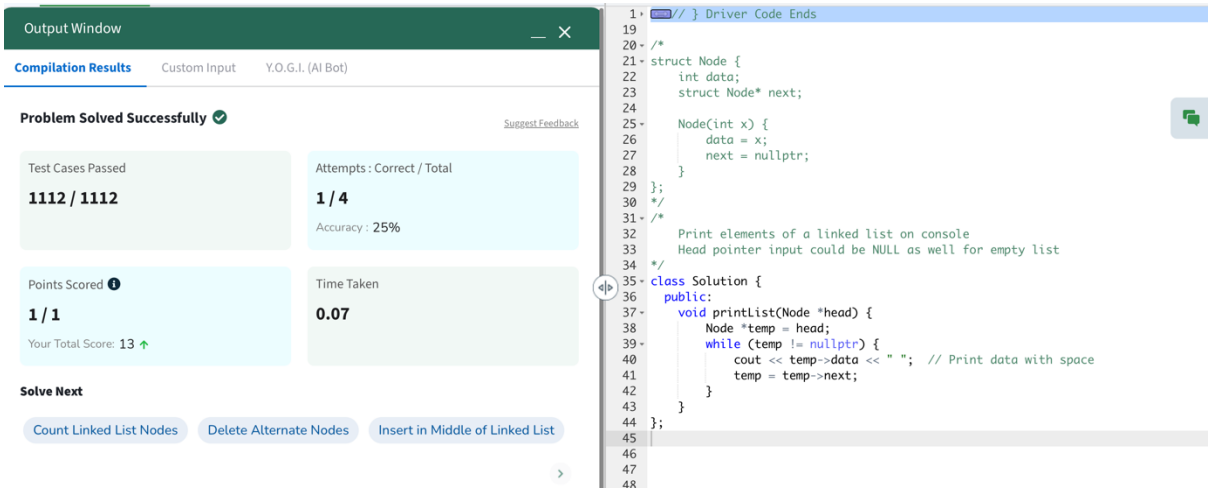
Solution 1:

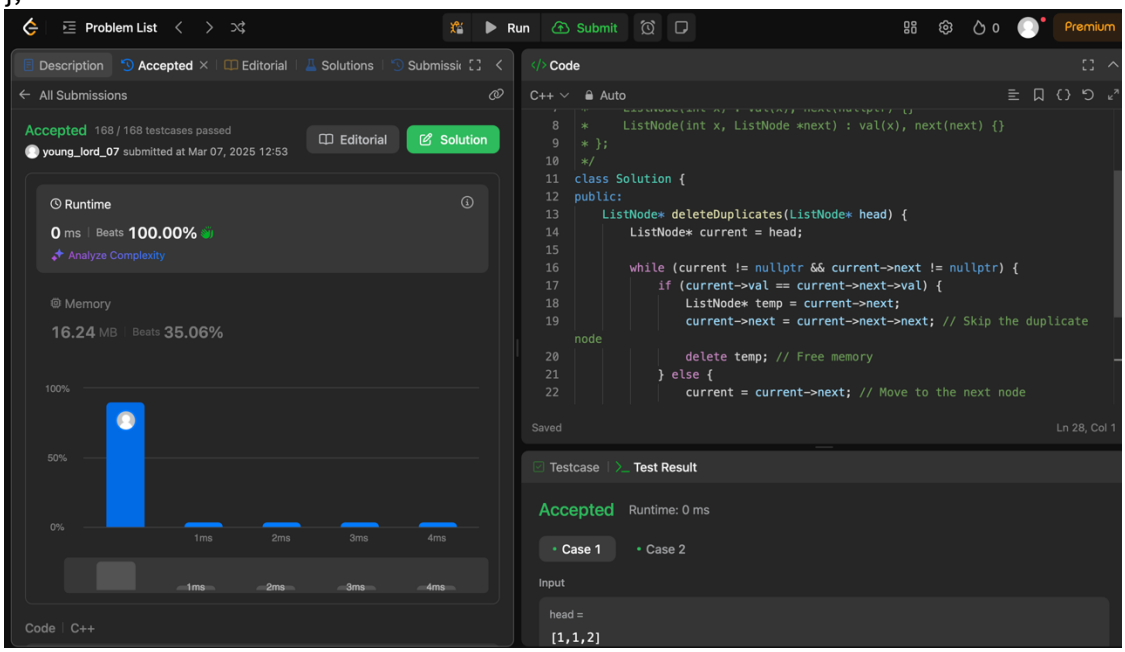
```
class Solution {
 public:
  void printList(Node *head) {
    Node *temp = head;
    while (temp != nullptr) {
      cout << temp->data << " ";  // Print data with space
      temp = temp->next;
    }
  }
};
```



Solution 2:

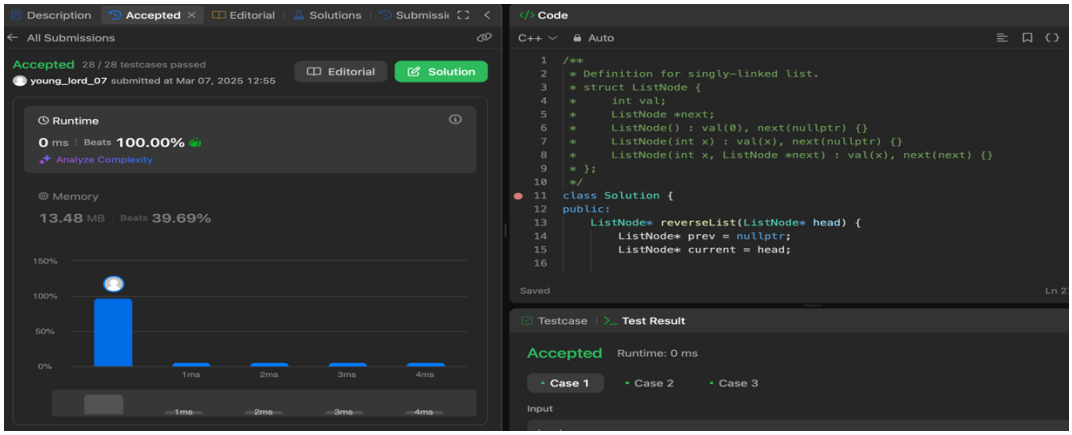
```
class Solution {
public:
  ListNode* deleteDuplicates(ListNode* head) {
    ListNode* current = head;

    while (current != nullptr && current->next != nullptr) {
      if (current->val == current->next->val) {
```

```
            ListNode* temp = current->next;
            current->next = current->next->next; // Skip the duplicate node
            delete temp; // Free memory
        } else {
            current = current->next; // Move to the next node
        }
    }
    return head;
  }
};
```



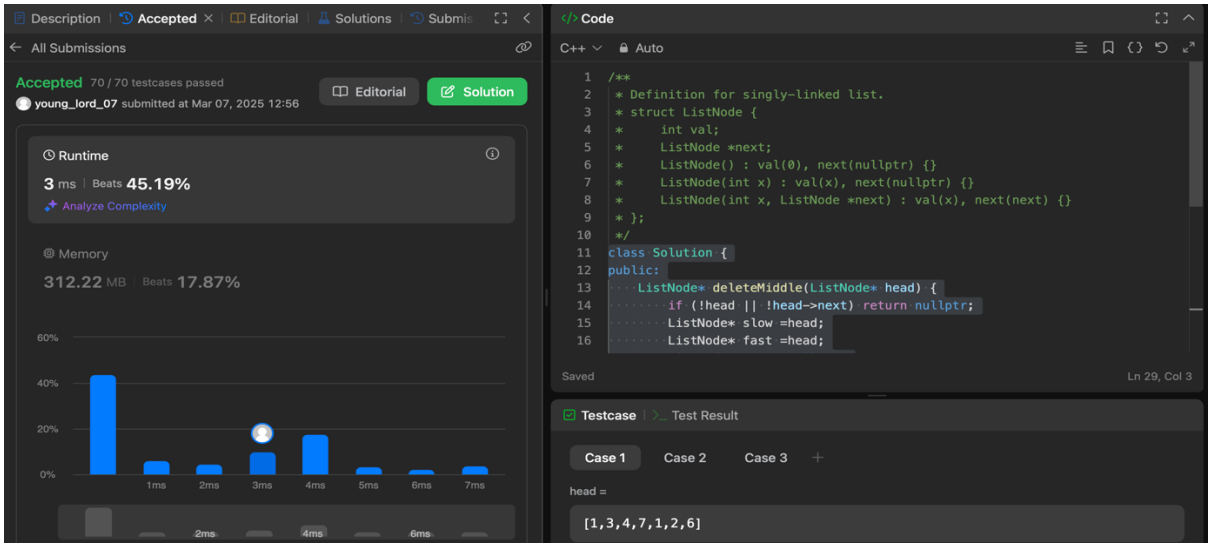
Solution 3:

```
class Solution {
public:
  ListNode* reverseList(ListNode* head) {
    ListNode* prev = nullptr;
    ListNode* current = head;

    while (current != nullptr) {
      ListNode* nextNode = current->next; // Store next node
      current->next = prev; // Reverse the link
      prev = current; // Move prev forward
      current = nextNode; // Move current forward
    }

    return prev; // New head of reversed list
  }
};
```



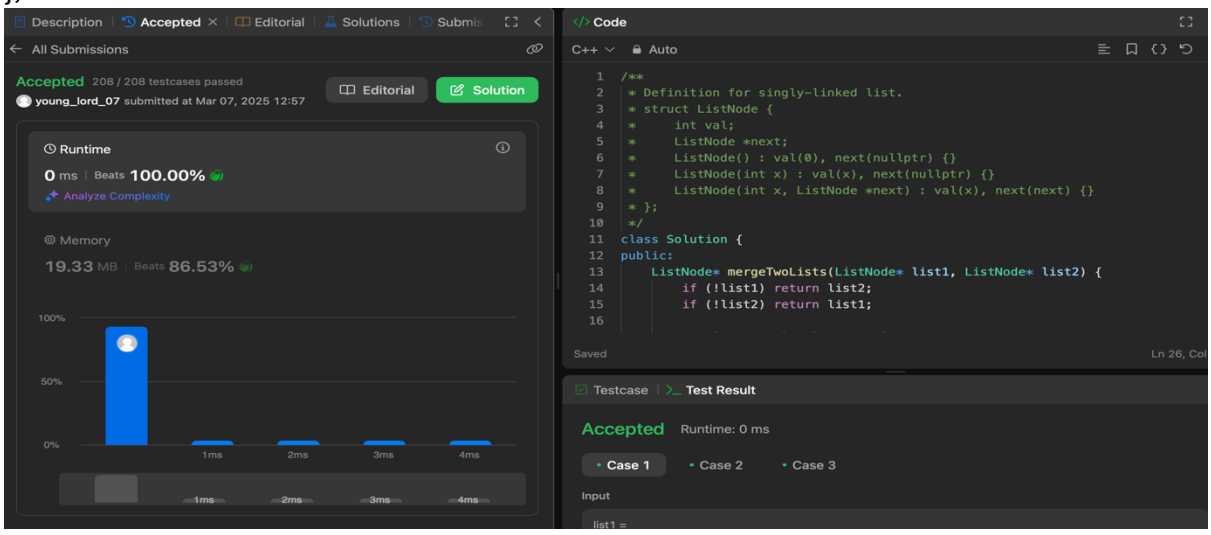
Solution 4:

```
class Solution {
public:
  ListNode* deleteMiddle(ListNode* head) {
    if (!head || !head->next) return nullptr;
    ListNode* slow =head;
    ListNode* fast =head;
    ListNode* prev =nullptr;

    while(fast && fast -> next){
      prev = slow;
      slow = slow ->next;
      fast = fast -> next -> next;
    }

    prev -> next = slow -> next;
    delete slow;
    return head;
  }
};
```



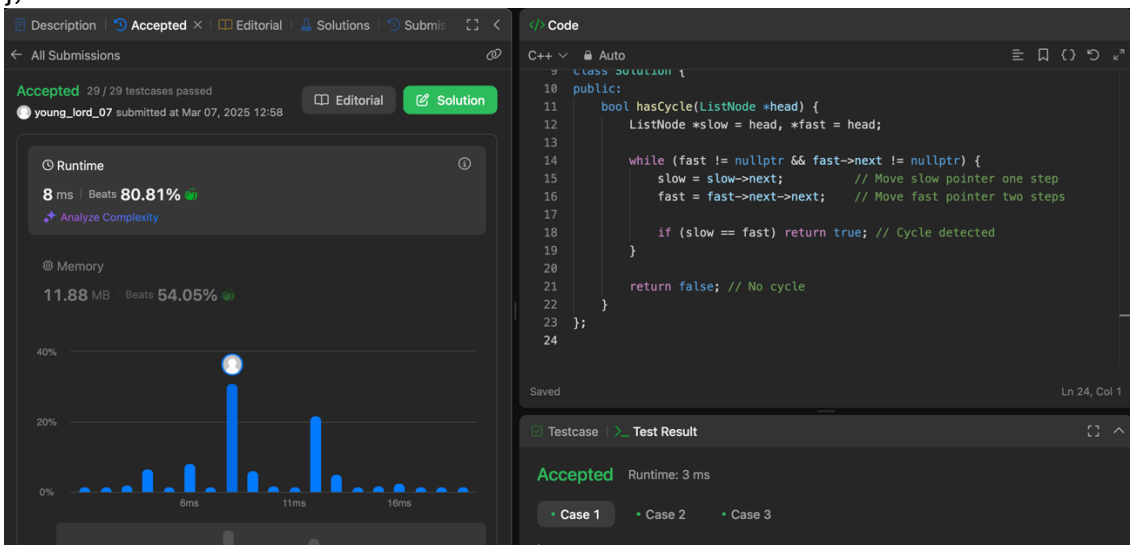
Solution 5:

```
class Solution {
public:
  ListNode* mergeTwoLists(ListNode* list1, ListNode* list2) {
    if (!list1) return list2;
    if (!list2) return list1;

    if (list1->val < list2->val) {
      list1->next = mergeTwoLists(list1->next, list2);
      return list1;
    } else {
      list2->next = mergeTwoLists(list1, list2->next);
      return list2;
    }
  }
};
```



Solution 6:

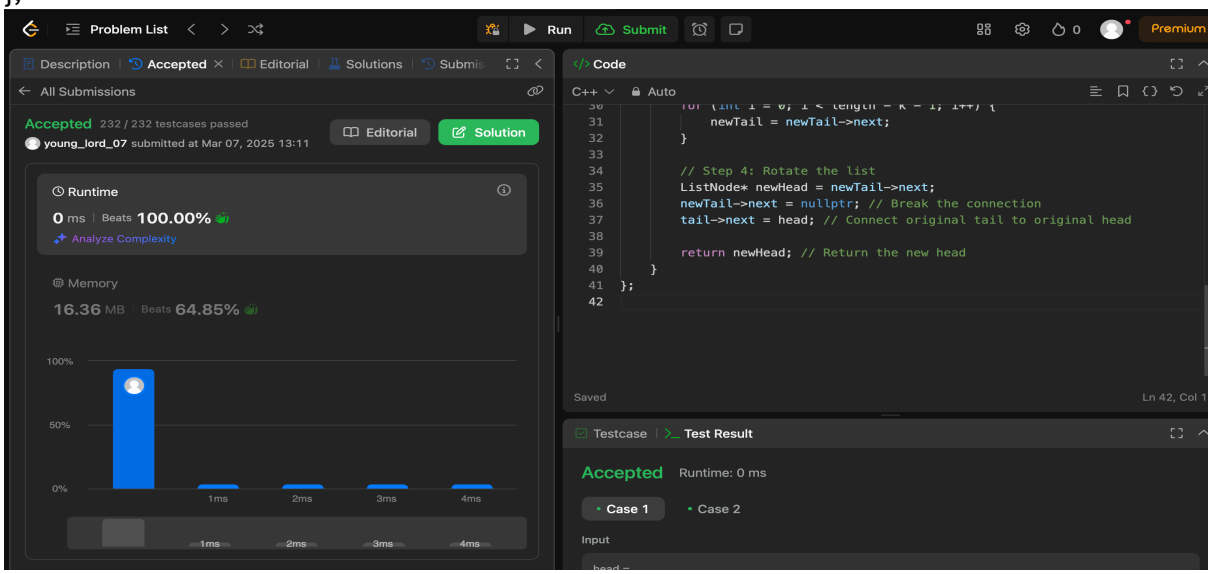
```
class Solution {
public:
  bool hasCycle(ListNode *head) {
    ListNode *slow = head, *fast = head;

    while (fast != nullptr && fast->next != nullptr) {
      slow = slow->next;        // Move slow pointer one step
      fast = fast->next->next;  // Move fast pointer two steps

      if (slow == fast) return true; // Cycle detected
    }

    return false; // No cycle
  }
};
```



Solution 7:

```
class Solution {
public:
  ListNode* rotateRight(ListNode* head, int k) {
    if (!head || !head->next || k == 0) return head; // Handle edge cases

    // Step 1: Compute the length of the list
    int length = 1; // Start from 1 since we count from the first node
    ListNode* tail = head;
    while (tail->next) {
      tail = tail->next;
      length++;
    }
```

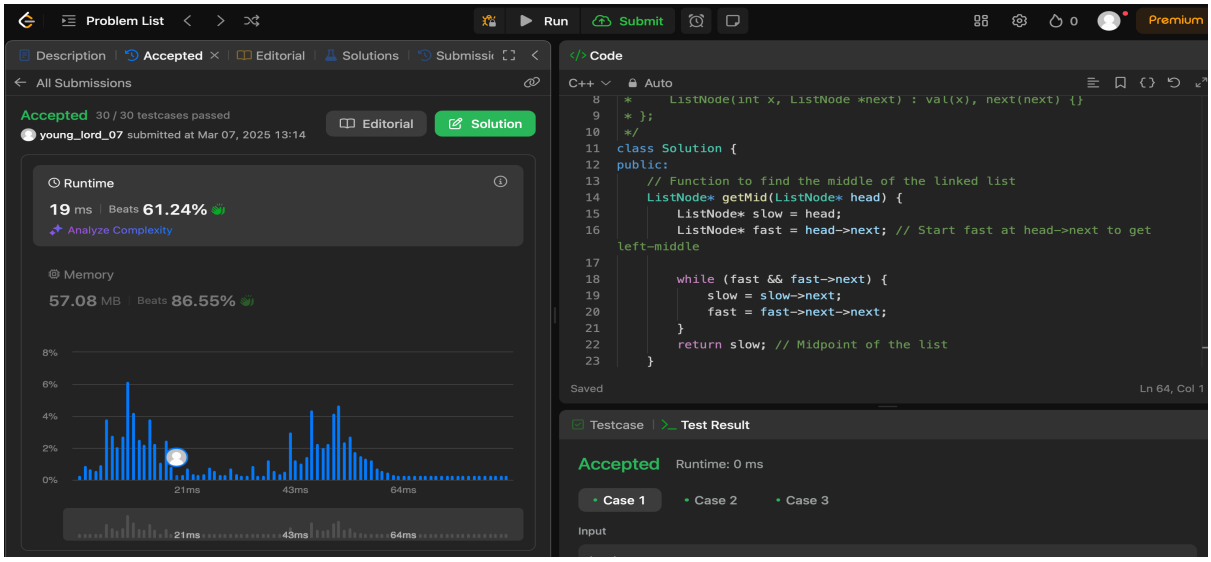
```
    // Step 2: Compute the effective rotation (as rotating `length` times gives the same list)
    k = k % length;
    if (k == 0) return head; // If `k` is a multiple of `length`, no change is needed

    // Step 3: Find the new tail (length - k - 1) and new head (length - k)
    ListNode* newTail = head;
    for (int i = 0; i < length - k - 1; i++) {
      newTail = newTail->next;
    }

    // Step 4: Rotate the list
    ListNode* newHead = newTail->next;
    newTail->next = nullptr; // Break the connection
    tail->next = head; // Connect original tail to original head

    return newHead; // Return the new head
  }
};
```



Solution 8:

```
class Solution {
public:
  // Function to find the middle of the linked list
  ListNode* getMid(ListNode* head) {
    ListNode* slow = head;
    ListNode* fast = head->next; // Start fast at head->next to get left-middle

    while (fast && fast->next) {
      slow = slow->next;
      fast = fast->next->next;
    }
    return slow; // Midpoint of the list
```

```
    }

    // Function to merge two sorted linked lists
    ListNode* merge(ListNode* left, ListNode* right) {
        ListNode dummy(0);
        ListNode* tail = &dummy;

        while (left && right) {
            if (left->val < right->val) {
                tail->next = left;
                left = left->next;
            } else {
                tail->next = right;
                right = right->next;
            }
            tail = tail->next;
        }

        // Append remaining nodes
        tail->next = left ? left : right;

        return dummy.next;
    }

    // Main function to sort the list using Merge Sort
    ListNode* sortList(ListNode* head) {
        if (!head || !head->next) return head; // Base case (1 or 0 nodes)

        // Step 1: Split list into two halves
        ListNode* mid = getMid(head);
        ListNode* rightHead = mid->next;
        mid->next = nullptr; // Break the list into two halves

        // Step 2: Recursively sort both halves
        ListNode* left = sortList(head);
        ListNode* right = sortList(rightHead);

        // Step 3: Merge two sorted halves
        return merge(left, right);
    }
};
```



Solution 9:

```
#include <queue>

class Solution {
public:
  struct Compare {
    bool operator()(ListNode* a, ListNode* b) {
      return a->val > b->val; // Min-heap based on value
    }
  };

  ListNode* mergeKLists(vector<ListNode*>& lists) {
    priority_queue<ListNode*, vector<ListNode*>, Compare> minHeap;

    // Push all non-null list heads into the heap
    for (ListNode* list : lists) {
      if (list) minHeap.push(list);
    }

    ListNode dummy(0);
    ListNode* tail = &dummy;

    while (!minHeap.empty()) {
      ListNode* node = minHeap.top();
      minHeap.pop();
      tail->next = node;
      tail = tail->next;

      if (node->next) minHeap.push(node->next); // Push next node of extracted list
    }
```

```
        return dummy.next;
    }
};
```